

CONSERVATION AGRONOMY TECHNICAL NOTES



U. S. DEPARTMENT OF AGRICULTURE

NEW MEXICO

SOIL CONSERVATION SERVICE

NOTE NO. 30

June 1, 1977

RE: RELATIONSHIPS OF CARBON TO NITROGEN IN CROP RESIDUES

The attached provides "Rule of Thumb Estimates" of the relationship of carbon to nitrogen in crop residues.

Additional copies of this Technical Note are available upon request from the State Office Plant Sciences Section.

Attachment

AO

TSC, Portland -2

Adjoining States -1

Director, Plant Sciences Division, SCS, Washington -2

" Rule of Thumb Estimates"
of the Relationship of Carbon to Nitrogen in Crop Residues

1. Carbon and Nitrogen Content of Soil Organic Matter and Crop Residues

	<u>Organic Carbon</u>	<u>Nitrogen</u>
Crop Residue	45%	0.1 - 2.5%
Soil Organic Matter	58%	3.0 - 6.0%

Average ratio of carbon to nitrogen in soil organic matter is 11.6 to 1 or 58% for carbon and 5% for nitrogen.

To convert organic carbon to soil organic matter multiply by 1.7.

To convert nitrogen to soil organic matter multiply by 20.

2. Importance of C:N Ratio in Relation to Crop Residues

- a. Conversion of organic carbon in crop residues to soil organic matter is dependent upon the amount of nitrogen present in the residues.
- b. Availability of nitrogen is determined by the C:N ratio. When the ratio is narrow (less than 30 or 35:1) nitrogen is released. If the ratio is wide (more than 30 or 35:1) nitrogen becomes temporarily unavailable.

3. Conversion of Crop Residues to Soil Organic Matter (figures are approximate).

- a. Crop residues contain about 45 percent organic carbon or 900 pounds per ton. Micro-organisms use 2/3 of this carbon, or 600 pounds per ton, to change it to CO₂. Three hundred pounds of carbon remains for use as soil organic matter. Three hundred pounds X 1.7 = 500 pounds (approximately) soil organic matter under favorable conditions.

- b. Both carbon and nitrogen are necessary to form soil organic matter. Assuming a soil organic matter-nitrogen ratio of 20:1, 500 pounds of soil organic matter will contain 25 pounds of nitrogen. Therefore, 25 pounds of nitrogen is required for the conversion of a ton of crop residue to about 500 pounds of soil organic matter when other conditions are favorable.
- c. Assume a nitrogen content in a ton of wheat straw at 0.25 percent. This is equal to 5 pounds of nitrogen. Since there is also 45 percent (900 pounds) of organic carbon in this ton of straw, the C:N ratio is 180 to 1. A nitrogen "tie-up" will occur as the amount of nitrogen needed for decomposing the residue is less than the approximate 25 pounds per ton required for this purpose. 20 pounds of commercial nitrogen must be added in this case to make the conversion to soil organic matter.
- d. Assume a nitrogen content in a ton of alfalfa at 2.25 percent. This is equivalent to 45 pounds of nitrogen. The organic carbon content is 45 percent or 900 pounds per ton alfalfa. The C:N ratio is 20:1. There is ample nitrogen (more than 25 pounds) to help convert a ton of alfalfa residue to soil organic matter. The nitrogen not needed for decomposing residues will be available for the next growing crop.

4. Carbon and Nitrogen Content in Crops

Crops	Carbon %	Nitrogen %	C:N Ratio
Alfalfa hay	43.1	2.34	18:1
Austrian peas (green manure)	45	2.53	18:1
Pea vines (mature)	44	1.5	29:1
Wheat straw (Tetonia, Idaho)	43.6	.49	88:1
Wheat straw (Moscow, Idaho)	43.6	.26	168:1
Wheat straw (Oregon)	44.7	.12	373:1

5. Data for Making Estimates

- a. About 2 percent of total nitrogen in the soil becomes available for plant use with fallow or irrigation.

- b. About 1 percent of total nitrogen in the soil becomes available for plant use under continuous cropping in non-irrigated areas.
- c. Crop residues require a minimum of 1.25-1.5 percent nitrogen to avoid a temporary depression effect on the amount of nitrogen in the soil.
- d. Approximately 500 pounds of soil organic matter (humus) is the maximum that can be developed in the soil from one ton of crop residue -- assuming all conditions are favorable for soil organic matter formation.